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# Ten Years of Progress in Machine Harvesting Fruit—Where We Are, and Where We Go From Here



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The research team of which I am a member is sponsored jointly by the U.S. Dept. of Agriculture and Michigan State University. Our group began its studies of mechanical harvesting in 1956, and a brief progress report was presented at the 1958 meeting of the Michigan State Horticultural Society. I have been back practically every year since with other reports on phases of the experimental work on mechanical harvesting. Your program committee suggested that on this, the 10th anniversary of our first report, I summarize the results so far achieved and tell you where, in our opinion, we go from here.

At the conclusion of my first presentation 10 years ago, a few growers said (and others no doubt thought) that fruit could never be harvested with machines. Time has proved that the pessimists were mistaken. During the season just past more than \$12,000,000 worth of Michigan grown fruit was harvested with machines, and the end is not yet in sight.

In an effort to avoid generalization, I am going to discuss individually eight Michigan grown fruit crops which are already being, or soon will be, extensively machine harvested.

APPLES

In 1959 the group, of which I am a part, machine harvested apples for the first time. A boom shaker was used to separate the fruit from the tree, and the apples were collected on a tarpaulin laid on the ground.

Although small-scale trials were continued during the next several years, human pickers were still available and the work did not receive much emphasis. However, by 1965 even apple growers were beginning to feel the effects of the picker shortage, and in that year 800 bushels of apples were included in the studies. Data on processing as well as harvesting was obtained. The results of this pilot operation were promising, and Herbert Teichman of Eau Claire, Michigan decided during the spring of 1966 to modify his cherry equipment in such a way that it could be used for harvesting apples. Teichman harvested almost 14,000 bushels of apples, all of which were sold to processors at the prices which were being paid for hand picked stock.

In-the-orchard studies of the Teichman operation, and an analysis of the results obtained when his machine-harvested apples were processed, revealed the following facts:

1. Apples could be machine harvested on a commercial basis
2. Machine picked apples could be successfully processed
3. A more maneuverable, heavy-duty shaker with variable frequency and a comparatively long stroke was needed
4. Collecting equipment designed primarily for apples was also needed.

While, as already stated, machine picked apples could be processed successfully, it is true that processing costs were sometimes higher, and the finished product yields were sometimes lower. However, the grade of sauce made from machine picked apples was usually just as high as the grade of sauce made from hand picked stock. The same thing was true when the two classes of apples were made into slices of grade "C". To make slices that would grade "A" from machine picked apples required more trimming, which in turn meant that the yield was proportionately less.

The differences were due to the bruises brought about by equipment deficiencies, and the 1967 trials were conducted in an effort to find solutions to equipment problems, and to give growers an opportunity to select equipment from a wide price range.

The effectiveness of several types of shakers was studied and the five types of collecting units listed below were tried.

1. An extensively modified cherry collecting unit made available for study by Herbert Teichman.
2. Shallow bulk boxes carried below decelerator strips in a mobile metal frame. This unit was designed and constructed by the USDA in cooperation with Michigan State University.
3. Strip-covered shallow bulk boxes—four such boxes placed, by means of a fork lift truck, under trees before shaking. This equipment was made available for trial by the Friday Tractor Company, of Hartford, Michigan.
4. Slope-sided frames—four to a tree. Designed by the Friday Tractor Co.
5. A roll-out unit consisting of a conveyor, collecting cloth and decelerator strips that could be extended and retracted mechanically. This prototype unit was constructed and made available for experimental use by Harvey Harvesters, Inc., of Grand Haven, Michigan.

All of these units had desirable features, and all of them will be subjected to further study during the 1968 season. In addition to the work being conducted by USDA and MSU personnel, several individual growers, including Rodney Bull of Bailey, Michigan, are also developing equipment and harvesting techniques.

Although extensive trials are being conducted and the results so far achieved are promising, all of the machines used in harvesting Michigan apples during the 1967 season were, as far as this crop is concerned, largely experimental. It will probably be several years before really effective apple machines can be developed, proven and made available to growers at

prices which will justify their purchase. While the majority of growers are likely to wait for improved equipment, there are those who will not or cannot do so. They will probably go ahead with the equipment that is now available.

One thing that makes apple harvesting problems more complex is the fact that they cannot be solved by equipment alone. Apple trees, as we know them now, will have to be extensively modified or replaced with smaller, specially trained trees before the machines now being developed can be used to maximum advantage.

I am going to conclude the apple harvesting discussion by saying that while a great deal of work is being done, and promising results have already been achieved, we are probably several years away from the sensational successes that have already been attained in machine harvesting some of the other fruit crops.

#### BLUEBERRIES

Our blueberry harvesting trials were initiated in 1957, and by 1959 the feasibility of the "shake and catch" method of harvesting this crop had been established. A prototype hand-held vibrator and a fruit collecting device, similar to the ones now in common use, had been developed and demonstrated. Equipment manufacturers were quick to see the possibilities of these devices, and commercially made units were made available and soon came into widespread use.

In 1959 our group made and tested the prototype of a large-capacity continuous harvester. Commercially made machines of this type became available in 1966. These units have a capacity of from 2,000 to 3,000 pounds per hour, and approximately 40 units have been sold. These machines perform best when used in harvesting mature, high bush varieties. The units are not quite as effective when used in picking smaller plants. However, present models are being modified and other continuous harvesters are being developed. Growers will soon be able to select the unit that serves their purpose best, from among machines of different size, capacity and price.

Mechanizing the picking operation has reduced average harvesting costs from approximately 8 cents to less than 2 cents per pound. More than 80 per cent of the Michigan blueberry crop is currently being machine harvested, and the percentage is nearing the upper limit. The monetary savings brought about by machine harvesting this crop probably amount to at least \$1,500,000 annually.

#### TART CHERRIES

Our research group turned its attention to tart cherry harvesting problems in 1956. Two years later a wheel-mounted fruit collecting unit was constructed and tested. Several types of mechanical shakers were tried, and by the end of the season the feasibility of harvesting tart cherries by the shake and catch method had been firmly established. Equipment manufacturers soon realized that the potential market for cherry harvesting machines was large and would probably prove lucrative.

During the next three seasons several types of unproved shakers and catchers were made and sold to growers. None of these proved satisfac-

tory, but in 1962 more effective equipment became available. In that year 24 of the hydraulic inertia shakers, that had been designed by one of the men in the United States Department of Agriculture, were made and sold. The growers who purchased these shakers also provided themselves with either hand-carried or self-propelled fruit collecting units.

By 1963 more than 60 harvesting machines were in the hands of growers, and although the crop was short the equipment was used in harvesting approximately 2,500,000 pounds of cherries. In 1964 the mechanically harvested tonnage jumped to 12,000,000 pounds. Up to this time some cherry processors believed that machine harvesting tended to lower quality, and in some instances they discouraged harvest mechanization.

However, studies of the relationships between mechanization and quality, made by Dr. Whittenberger and other members of the research group, proved conclusively that when well-designed harvesting equipment was properly used, the quality of the cherries was equal to, and in many cases superior to that of hand picked fruit. Establishing this fact, along with the development of an effective destemmer by the Smeltzer Brothers, materially accelerated the trend to mechanization.

By 1967 more than 350 Michigan growers had well-designed equipment and a knowledge of how it should be used. Processors had come to realize that properly used machines did not destroy quality, and that mechanization was inevitable. In that year more than 40,000,000 pounds of Michigan grown cherries (47 per cent of the crop) were machine picked. The average labor cost of the operation was about 1.1 cents per pound. The cost of hand picking was approximately 5 cents per pound. The monetary savings, after figuring in amortization charges on the equipment, was well over \$1,000,000. Orders for more than 100 machines have been placed for units that are to be delivered in time for the 1968 harvest. If Michigan produces a normal crop, it is safe to say that more than 100,000,000 pounds of cherries will be machine harvested in 1968.

While we have good equipment and a knowledge of how it should be used, improvements are sure to be made which will make the operation both easier and less expensive.

#### SWEET CHERRIES

Our research group began its sweet cherry harvesting studies in 1956. More than 95 per cent of the sweet cherries grown in Michigan are brined. Maraschino packers prefer cherries that have not developed deep red color, and growers have been asked to harvest their cherries before they reach full maturity. The results of the preliminary studies indicated that at this stage of development the cherries were firmly attached to the tree and difficult to harvest with machines. However, the supply of seasonal help has dwindled rapidly, and during the last few years the need for a practical method of machine harvesting became very acute. Efforts to solve the problem were stepped up with gratifying results.

The big "break through" came during the 1966 and 1967 seasons when two things of great significance were learned; 1) that sweet cherries can be successfully harvested with machines if they are allowed to become fully mature; and 2) that immediately-after-harvest brining tends to produce a cherry of better color and superior quality than can be obtained when the fruit is brined later. Detailed reports on this work are being prepared and will be made available early in 1968.

During the 1966 season 19 Michigan growers used machines on an experimental basis in harvesting sweet cherries. Although most of the operations were on a relatively small scale, they were all quite successful and this fact was given wide publicity. As a result, almost 100 growers used machines in 1967, and more than 2,000,000 pounds of sweets were harvested in this manner.

Although we have the basic information necessary to machine harvest sweet cherries successfully, we still need shakers with more power—sweet cherry trees grow larger than tart cherry trees. We also need a brine which will bleach the color out of more mature fruit. If such a brine is not found, growers may have to find canner rather than briner outlets. Mechanization has undoubtedly come to stay, and new markets will have to be found or more effective brining techniques worked out.

#### PLUMS

Our group demonstrated the feasibility of machine harvesting Stanley prune-plums in the 1958 and 1959 seasons. A report entitled, "MECHANIZING THE HARVEST OF PLUMS" was published, and some growers began using the "shake and catch" method almost immediately. Although the number of growers who machine harvested plums increased gradually during the next several years, it was not until 1966 and 1967 that the trend became pronounced. Almost half of the 1967 crop was machine picked; and inasmuch as the number of cherry harvesting systems, which can be used for plums as well as cherries, is increasing rapidly, the percentage of the plum crop which is machine harvested is sure to continue to increase. Growers who do not own the necessary equipment can usually arrange to have their plums harvested on a custom basis.

#### PEACHES

It will probably be necessary to hand pick, for some time at least, peaches that are destined for the fresh fruit market. However, some growers have been successfully machine harvesting clingstone varieties for some time. Other producers who care to use the "shake and catch" method could, no doubt, do the same thing.

#### PEARS

Michigan grown pears were machine harvested on an experimental basis in 1958, and small-scale trials have been continued. The results of this work indicate that pears can be separated from the tree quite readily. However, pear trees tend to grow tall and upright, and many of the fruits separated by shaking not only fall from a considerable height, but they fall through the tree. In doing so they often strike branches and/or other fruits and the collecting device with considerable force. While the bruises thus incurred are not always immediately apparent, they do show up during the ripening process and are so serious that, for the present at least, machine harvesting is not recommended for pears. However, the more effective collecting equipment that is now being developed, and cultural practices which will lower and spread the tree, will no doubt enable growers to machine harvest this fruit successfully in the near future.

## RASPBERRIES AND BLACKBERRIES

The members of our research group were invited to help evaluate a recently developed raspberry and blackberry harvester used in several commercial plantings during the 1966 and 1967 seasons. Inasmuch as the data obtained covers only the latter part of the 1966 season and the 1967 season (in which the raspberry crop was abnormally light) the data are somewhat inconclusive. However, the tentative findings indicate that the harvester in question not only provides a practical means of harvesting raspberries and blackberries, but may also prove useful in picking blueberry plants of medium size. There is also reason to believe that it can be used to advantage in harvesting currants and possibly other horticultural crops.

## CONCLUSIONS

To machine harvest successfully we must have 1) a plant that lends itself to this technique, 2) properly designed equipment, and 3) a knowledge of how the machines can be used to advantage.

We already have in Michigan four or five important fruit crops which can be successfully machine harvested. There are several others which will probably be added to this list in the near future. Equipment manufacturers have already placed several well-designed harvesting machines on the market. Others are being developed and will soon become available. Growers are learning to operate their machines effectively and to make the necessary modifications in their trees and plants. The future of machine harvesting looks bright indeed.